**SMD Operations Procedures Manual**

# 8.1.1.37 OPERATION OF THE NGC LONG COIL WINDER

Text Pages 1 through 29
Attachment(s) 1-7

**Hand Processed Changes**

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## 1.0 Purpose and scope

1.1 To provide instruction in the operation of the long coil winder located in building 924.

## 2.0 Responsibilities

2.1 Authorized operators of the winder shall perform the tasks described here. A list of operators is maintained by the coil fabrication plant manager.

2.2 The operator shall read and complete the following documentation:

2.2.1 Daily log book for coil programs. Entries shall include any information that the operator deems important to pass along to the coil fabrication supervisor, the Cognizant Engineer, or the next work shift, including:

A) Work accomplished regarding coil production.

B) Coil discrepancies.

C) Repairs to the winder (brief description).

D) Lessons learned.

E) Irregularities during operation of the winder.

2.2.2 Maintenance log. Entries shall include.

A) Each repair and maintenance procedure.

B) Parts and material used.

2.2.3 Traveler associated with the coil being wound.

2.2.4 Interlock test form.

## 3.0 Prerequisites

3.1 Training

3.1.1 Operators shall be trained by the coil winding/curing technician supervisor before using this procedure.

3.1.2 Operator shall be trained as an "knowledgeable employee" as defined by BNL ES&H Standard 1.5.1, "Lockout/Tagout Requirements."

3.1.3 Specific steps of this procedure contain Electrical & Mechanical Assembly operations that impact the environment. Prior to performing these steps, personnel shall complete the applicable facility specific environmental training.

3.2 Equipment

3.2.1 Safety glasses with side shields, or goggles.

3.2.2 15 Mil shim for Lump Detector set-up.

3.2.3 Chatillion Dial Push-Pull Gauge Model DPP - full scale deflection 0.1". (For Calibration).

## 4.0 Precautions

4.1 Verify that all guards and shields are in place.

4.2 Verify that work area within the yellow border is clear of unauthorized personnel.

4.3 Wear eye protection while cable is under tension.

4.4 Do not wear loose clothing or hanging jewelry. Keep long hair tied up.

4.5 Test the interlocks on a six month interval. The test method is described in section 5.23.

4.6 Verify that the cable is threaded through the guide wheels as per attachment.

## 5.0 Procedure

5.1 Overview Of The Long Coil Winder

5.1.1 The winder provides a means of winding superconducting cable into magnet coils.

5.1.2 The cable is wound off of its spool through a series of guide wheels, then onto a mandrel and centerpost assembly.

5.1.3 The cable spool is mounted to a rotating carriage that can move clockwise or counterclockwise. See section 5.24 for procedure on changing carriage direction.

5.1.4 The mandrel assembly rests on bearing assemblies attached to the table that allows the mandrel assembly to be rotated.

**NOTE**

**The mandrel assembly has an internal volume of oil used for curing. If leakage is detected from the mandrel quick disconnects (located on its end), the oil shall be cleaned up immediately and disposed of as regulated industrial waste.**

5.1.5 Carriage and mandrel motion is controlled by the operator in manual mode or by the programmable motion controller in auto mode.

5.1.6 As the coil is wound, lamination end spacers and copper wedges are inserted between the windings at specified locations to give the coil the proper shape and size.

5.2 Operator Controls

5.2.1 Position Controller Panel (Attachment 4)

5.2.1.1 Control Cabinet Main Power On/Off Switch: On RH side of Panel. Activates power to the Position Controller Panel.

5.2.1.2 Voltage Display: Indicates voltage on all three phases of power supply.

5.2.1.3 Frequency Display: Indicates AC frequency.

5.2.1.4 Hand /Auto: Determines manual or program mode for control.

5.2.1.5 Carriage /Mandrel controls: Under HAND mode, these control motion of carriage and mandrel. REF lights illuminate to indicate "home" position. Low / High

speed buttons control speed of carriage (C/C/W is the normal counterclockwise direction, C/W is for clockwise).

5.2.1.6 Turn Display: Indicates turn number being wound.

5.2.1.7 Carriage Pos. Display: Indicates position of carriage from home.

5.2.1.8 Mandrel Angle Display: Indicates angular position of mandrel (with sign).

5.2.1.9 Auto Start (Auto Mode): Begins execution of a winding program.

5.2.1.10 Auto Stop (Auto Mode): Halts execution of a winding program.

5.2.1.11 Auto Continue. (Auto Mode): Resumes execution of a winding program.

5.2.1.12 Emergency Stop Button: Halts movement of the mandrel and the carriage. It is a mushroom type push button with must be manual reset (pulled-out). De-activates power to the control motors.

5.2.1.13 Start Button: Activates power to the control motors.

5.2.1.14 Stop Button: De-activates power to the control motors.

5.2.2 Remote Control

5.2.2.1 Emergency Stop Button: Halts movement of the mandrel and the carriage. It is a mushroom type push button which must be manually reset (pulled-out). De-activates power to the control motors. Works ONLY in the auto mode.

5.2.2.2 Carriage Advance /Carriage Reverse: Provides manual control of carriage.

5.2.2.3 Mandrel CW /CCW: Provides manual control of mandrel rotation.

5.2.2.4 High /Low Buttons: Controls movement speed of carriage.

5.2.2.5 Start Button: Activates power to the control motors.

5.2.3 Carriage Panel - Front (Attachment 1)

5.2.3.1 Tension Control: Allows for adjustment of tension.

5.2.3.2 Motor Circuit: Display in mA of current applied to spindle motor.

5.2.3.3 ON /OFF (located to the left of "AUTO/MAN" switch): Applies power to tension control circuitry.

5.2.3.4 AUTO/MAN Switch: Must be left in "MAN" position.

5.2.3.5 TENSION Meter: Non-functional at this time.

5.2.3.6 POWER ON/OFF Switch (Located below Tension Meter): Applies power to spindle motor.

5.2.3.7 Power (OFF/ON): Activates power to the cable guide height control motor (YELLOW light).

5.2.3.8 Jog /Run Control: Selects between manual and automatic (electric eye) control of the wire guide height controller.

5.2.3.9 Stop Button: De-activates power to the cable guide height controller (RED light).

5.2.3.10 Jog Rev. Button: Moves the cable guide height controller down (JOG mode only).

5.2.3.11 Start Button: Activates power to the cable guide height controller (GREEN light).

5.2.3.12 Jog For. Button: Moves the cable guide height controller up (JOG mode only).

5.2.3.13 Engage Spindle Motor Brake /Release (On side of controller): Locks spindle drive motor. Light illuminates to indicate spindle brake is released. The spindle brake may be engaged at any time without re-starting programs or control power.

**CAUTION**

**Do not operate carriage or mandrel motors with brake engaged and cable attached to center post. Spindle brake will engage while carriage is in motion, damaging coil and cable.**

5.2.4 Lump Detector (located on top of carriage)

5.2.4.1 Power ON/OFF toggle switch: Controls power to the lump detector.

5.2.4.2 Black reset push button: Resets the audio alarm.

5.2.4.3 Voltage potentiometer. Adjusts voltage to activate audio alarm.

5.2.4.4 DC voltmeter: Not used.

5.3 Turning On The Power Supply

**NOTE**

**The power supply consists of a 480v /60hz /30h.p. Motor powering a generator with an output of 380v / 50hz / 3 phase.**

5.3.1 Verify the following initial settings:

A) 480 volt service disconnect (located behind the coil winder control cabinet) is "ON".

B) Coil winder 30 amp circuit breaker is "ON".

C) Control cabinet main power switch is "OFF".

D) Computer is "OFF".

5.3.2 Press "START" pushbutton (located on the wall) to turn "ON" the power supply.

5.3.3 Looking at the control cabinet; verify the three voltage meters read 220 +/-2 volts and the frequency meter reads 50hz.

**NOTE**

**If any of the meters do not read the specified voltage or frequency; press the "stop" pushbutton to turn off the power supply and notify the cognizant engineer or supervisor.**

5.3.4 Switch control cabinet main power to "ON".

5.3.5 Power is now available to coil winding machine.

5.4 Shutting Down The Power Supply

5.4.1 Turn "OFF" the computer.

5.4.2 Switch control cabinet main power to "OFF".

5.4.3 Press "STOP" pushbutton (located on the wall) to turn "OFF" the power supply.

5.5 Computer Start Up Procedure (Manual Control)

5.5.1 Verify that the power supply is operating. See section 5.3.

5.5.2 Turn the control cabinet main power switch (located on the right side of the cabinet) to the "ON" position (handle vertical).

5.5.3 Turn "ON" the computer; wait for the main menu to be displayed on the monitor.

5.5.4 Place the "HAND/AUTO" switch (located on the Postion Control Panel) to the hand (manual) position.

5.5.5 Place the remote control key switch to "OFF" position (key vertical).

5.5.6 Verify that the crash buttons are not activated by pulling up on the remote control and the position controller crash buttons.

5.5.7 Setting the remote control mode:

5.5.7.1 To operate the winder using the remote control:

A) Place the over-ride toggle switch (located inside the rear of the computer cabinet) to the "OFF" position.

B) Turn the remote control key switch to the "ON" position.

5.5.7.2 To operate the winder without the remote control:

A) Place the over-ride toggle switch (located in the rear of the computer cabinet) to the "ON" position.

**CAUTION**

**Do not use the remote control in this mode. The remote control will operate with the crash button disabled.**

5.5.8 Set the tension control knob (located on the carriage) counter clockwise to the stop or lowest setting. Press the green "START" (motor control) button on the Position Control Panel, hold for three seconds and release.

**CAUTION**

**Be sure all personnel are away from the carriage and mandrel before pressing the start button.**

5.5.9 An alarm will sound on the carriage. Go to the carriage and press the "GREEN" start push button to silence the alarm. The green "run" light should illuminate indicating the automatic cable height adjuster is powered.

5.5.10 Manual control of the winding machine is now possible.

5.5.11 Mandrel and carriage position encoders must be calibrated at this time to start a new coil or create a new winding program. See section 5.11.

5.5.12 To wind a coil manually, drive to the start position and prepare the cable using section 5.10.

5.6 Executing winding programs from the beginning

5.6.1 Go to the main menu.

5.6.2 Type 3 then hit RETURN. If the mandrel and carriage axis have not been calibrated you will see a message on the screen telling you to to do it. To do this you must:

A) Hit STRG and hold then hit PAUSE (this breaks the program).

B) Type RUN "LO" then hit RETURN. (that is a zero after the L). Main menu should appear.

C) Calibrate per separate procedure titled "calibration of encoders for mandrel and carriage position".

D) Execute program procedure from main menu.

5.6.3 Place the "HAND/AUTO" switch on the Position Control Panel in the auto position.

5.6.4 Type "Y" then hit RETURN to continue, or type "M" then hit RETURN to go to the main menu.

5.6.5 Type "Y" then hit RETURN if cable type is ok.

5.6.6 Type "Y" then hit RETURN if cable quantity is adequate.

5.6.7 Type “S” then hit RETURN.

5.6.8 Type “file name” listed in MAP then hit RETURN.

5.6.9 Press auto start button on the Position Control Panel, or the start button on the remote control to start the program.

5.6.10 Program will begin.

5.6.11 Work instructions will appear on the LED Display to prompt you to perform tasks. After you have completed the work, you must hit RETURN, or press the start button on the remote control to continue.

5.6.12 When program is complete, the message "file executed to end" will appear. Do the following:

A) Press the AUTO STOP button on the Position Control Panel.

B) Place the "HAND/AUTO" switch on the Position Control Panel in the HAND position.

C) Hit RETURN

D) Hit RETURN again.

E) Main menu should appear.

5.6.13 Cut cable and shut down computer per section 5.12.

5.7 Executing Winding Programs From The Middle

5.7.1 Go to the main menu.

5.7.2 Type “3” then hit “RETURN”. If the mandrel and carriage axis have not been calibrated you will see a message on the screen telling you to do it. To do this you must:

A) Hit STRG and hold then hit PAUSE (this breaks the program).

B) Type RUN "LO" then hit RETURN. (that is a zero after the L). Main menu should appear.

C) Calibrate per section 5.11.

D) Execute program procedure from main menu.

5.7.3 Place the "HAND/AUTO" switch on the Position Control Panel in the auto position.

5.7.4 Type “Y” then hit RETURN to continue, or type “M” then hit RETURN to go to the main menu.

5.7.5 Type “Y” then hit RETURN if cable type is ok.

5.7.6 Type “Y” then hit RETURN if cable quantity is adequate.

5.7.7 Type “P” then hit RETURN.

**NOTE**

**When you are continuing a program, the carriage and mandrel must be in the same position as they were when you stopped running the program. Check current positions shown on the position controller ,with those that were recorded when you stopped the program. If positions do not match, call supervisor.**

5.7.8 Type “file name” then hit RETURN

5.7.9 Wait for the message "press auto continue" to blink on the screen. When it does, look at the aim point listed on screen, and verify that it is correct.

5.7.10 Press “AUTO CONT" (auto continue) button on the Position Control Panel, or the start button on the Remote Control to start the program.

5.7.11 Work instructions will appear on the LED Display to prompt you to perform tasks. After you have completed the work, you must hit RETURN, or press the start button on the remote control to continue.

5.7.12 When program is complete, the message "file executed to end" will appear. Do the following:

A) Press the “AUTO STOP” button on the Position Control Panel.

B) Place the "HAND/AUTO" switch on the Position Control Panel in the "HAND" position.

C) Hit RETURN.

D) Hit RETURN again.

E) Main menu should appear.

5.7.13 Cut cable and shut down computer per section 5.12.

5.8 Pausing A Running Program

5.8.1 The program can be stopped at any time by pressing the "auto stop" button on the Position Control Panel, or the "stop" button on the remote control.

**NOTE 1**

**During a program stop, never turn off power to the computer or Position Controller Panel.**

**NOTE 2**

**If you are stopping for an extended period of time, you must:**

**A) Record mandrel and carriage positions (in case of power drop).**

**B) Clamp cable to mandrel (to prevent loosening).**

**C) Place main brake switch (located on the side of the carriage) in the "engage" (down) position.**

**D) Turn the tension control knob (located on the front of the carriage) fully counter clockwise.**

**NOTE 3**

**During a program stop , the carriage and mandrel can be manually driven. To do this you must place the "hand/auto" switch in the hand position. When done, return the switch to the auto position.**

5.9 Restarting A Program

5.9.1 Reset tension if it was shut down. See section 5.10.

5.9.2 Press the "start" button, on the Remote Control, or press the AUTO CONT (auto continue) button on the Position Control Panel.

5.10 Cable Loading And Tension Adjustment

5.10.1 On front of carriage control panel, set "AUTO/MAN" switch to "MAN".

5.10.2 Put Spindle Motor brake switch (located on the side of the carriage) to the "engage brake" or down position. Light should go "off".

5.10.3 Turn the tension control knob (located on front of carriage) fully counterclockwise.

5.10.4 Load cable spool onto the carriage spindle.

5.10.5 Verify cable keystone major edge is up and the cable is paying off the spool clockwise.

**NOTE**

**Spindle drive direction is counter clockwise**

5.10.6 The following must be done with 2 technicians: manually remove enough cable (~4 turns/19ft.) To thread the carriage guide pulleys.

**CAUTION**

**Be sure the cable does not get twisted, damaged or contaminated.**

5.10.7 Secure cable on spool with "Kapton" tape.

5.10.8 Thread cable through the guide pulleys and secure in carriage clamp.

5.10.9 Prep end of cable. Tin end of cable and apply a stringer bead using 96% tin, 4% silver solder.

**NOTE**

**Ensure unused solder is recycled or disposed of properly**

5.10.10 Remove cable from carriage clamp and secure cable in centerpost.

5.10.11 Manually work the cable slack to the side of carriage with the tension controls and hold by hand.

**CAUTION**

**Be sure cable is properly placed in guide pulleys.**

**WARNING**

**Pinch hazard: be sure to keep hands clear of guide pulleys**

5.10.12 While holding the cable to remove the slack, “RELEASE” the spindle brake and allow the slack to be taken up.

5.10.13 On the front of the Carriage Panel, place the "TENSION POWER ON/OFF" switch (located below tension meter) & the "TENSION ON/OFF" switch (located to the left of "AUTO/MAN" switch) to the ON position.

5.10.14 Set tension as required or prompted on message display.

5.11 Calibration Of Encoders For Mandrel And Carriage Position

5.11.1 Place "HAND/AUTO" switch (located on the Position Control Panel) in the "HAND" position.

5.11.2 With view looking from the lead end mandrel motor end of table. Swing mandrel fully to the left ccw.

5.11.3 Place the carriage so that it is 2-4 inches away from engaging the electric eye (carriage position/turn count sensor)on the table, in its normal operational rotation.

5.11.4 Turn off the position controller, by flipping the toggle switch located on the back of the Position Control Panel. Access can be gained to this switch by opening the Position Control Panel cabinet door. Wait five seconds, then turn the switch back on.

5.11.5 Press the green start button on the Position Control Panel, and hold until it illuminates.

5.11.6 Go to carriage, press green start button to reset alarm.

5.11.7 Type 8 on the keyboard, then hit RETURN. This sends the parameters to the controller.

5.11.8 With view looking from the lead end, swing the mandrel fully to the right, then swing it to the left until the bottom "REF" light on the Position Control Panel is illuminated.

5.11.9 Move the carriage forward (in the normal winding direction) until the top "REF" light on the Position Control Panel or the “YELLOW” light on the carriage position/turn count sensor illuminates.

5.11.10 Calibration is now complete, and will remain until power is interrupted to the Position Controller Panel.

5.12 Cable Cutting and Computer Shut Down

**NOTE**

**This procedure should only be performed if a coil has been completed. Power should never be turned off when a coil is in progress.**

5.12.1 Clamp off cable to the mandrel so that coil will not loosen.

5.12.2 Wrap 1 inch Kapton tape around the cable in the location that the cable will be cut. This is to prevent fraying.

5.12.3 Lower cable tension by slowly turning the tension control knob (located on the front of the carriage) counter clockwise. As you are lowering the tension, pull on the cable so that when the spindle brake automatically engages, there will be play in the cable.

5.12.4 Place the spindle motor brake switch (located on the side of the carriage) in the engage position (switch down).

5.12.5 Turn the computer main power switch (located on the side of the computer cabinet) to the off position.

5.13 Calibration of the Tensioning System

**NOTE 1**

**You must be listed as an authorized calibration technician before performing the sections of the procedures designated to be performed by the "calibration technician." A current list is available in the Superconducting Magnet Division Calibration Group office.**

**NOTE 2**

**An authorized operator will perform this procedure at the start of every production run and once a month thereafter during production.**

**NOTE 3**

**A qualified calibration technician will perform adjustments to the long dipole cable tensioning system when required.**

5.13.1 Secure a 2-3 foot length of cable to the mandrel centerpost. The type of cable should match the tooling.

5.13.2 Attach the force gauge to the cable. Use a Chatillon dial push-pull gauge, model DPP, full-scale deflection is 0.1 inch.

5.13.3 Mount spool of cable to carriage.

5.13.4 Run cable through guide wheels per section 5.10. Attach cable to other end of force gauge.

5.13.5 Position carriage so that the cable is in a straight line parallel to the centerpost from the last guide wheel, through the force gauge, to the point of attachment on the centerpost.

5.13.6 Rest the force gauge on the mandrel. Zero the gauge.

5.13.7 Turn on the tension controller as per section 5.10.

5.13.8 Adjust the tension controller potentiometer until the digital display on the controller box reads 5 lbs. Observe the "actual" tension read from the force gauge dial. Record your reading on the calibration form. (Attachment 6).

5.13.9 Increase the tension in 5 lb. Increments from the tension controller digital display. Record all reading from the force gauge dial to the calibration form.

5.13.10 Repeat step until a tension of 45 lbs. is reached.

5.13.11 If all the reading are within the specified tolerance of +/-2.5 lbs., then perform the following steps:

A) Dismantle the set-up.

B) Complete the calibration form.

C) Affix a calibration sticker or form to the tensioning controller box.

5.13.12 If one or more readings are outside the specified tolerance of +/- 2.5 lbs, then the calibration technician will adjust the tension controller by following the procedure in section 5.14. If the calibration technician is able to make the necessary adjustments to the cable tension controller, and the dial readings are within the specified tolerance, then repeat steps 5.13.1 – 5.13.11.

5.13.13 If the calibration technician can not adjust the tension controller within the specified tolerance, then perform the following steps:

A) Immediately inform the cognizant engineer and the coil fabrication supervisor.

B) Do not dismantle the set-up before consulting with your supervisor. Others may want the opportunity to verify your findings.

C) Make the necessary notations on the calibration form that the tension control systems could not be adjusted to within specifications.

D) Repeat this procedure when the cognizant engineer has completed the necessary repairs.

5.14 Calibration of the Tension Meter

5.14.1 Turn tension control knob (located on the front of the carriage) fully counter clockwise.

5.14.2 Thread machine and attach cable to the mandrel with a calibrated "fish scale" in line, between the last guide pulley and the mandrel.

5.14.3 Place the spindle motor brake switch (located on the side of the carriage) in the release position (up).

5.14.4 Turn the tension control knob clockwise until tension is felt.

5.14.5 Let meter settle and compare readout to the "fish scale" reading.

5.14.6 Raise tension to 40-lbs. On the meter and verify that the "fish scale" reading is the same.

5.15 Set-Up of Lump Detector

5.15.1 Set Lump Detector Power switch to ON.

5.15.2 Insert 15-mil shim between cable and detector.

5.15.3 Adjust Voltage Potentiometer counter clockwise until alarm trips.

5.15.4 Hit reset. If alarm does not stop, adjust voltage potentiometer downward in small increments, hitting reset button at each increment, until alarm stays off.

5.15.5 Remove shim. The Lump Detector alarm is set.

5.16 Miscellaneous Winding Commands

5.16.1 To stop a winding program while it is running: hit and hold STRG then hit PAUSE (this is called a "break").

5.16.2 To restart a winding program from the point at which a "break" occurred: type "CONT" then hit return.

5.16.3 To restart a winding program after a "break" from the beginning: type RUN then hit return.

5.16.4 To return to the main menu after a break: type RUN LO then hit RETURN.(use the number "zero" in the command, not the letter "O").

5.16.5 To get to the main menu from DOS or NORTON: type GRUMMAN then hit RETURN

5.17 Creating A New Coil Winding File

5.17.1 Go to the main menu.

5.17.2 Verify that the "HAND/AUTO" switch (located on the Position Control Panel) is in the hand position.

5.17.3 Type “1” then hit RETURN.

5.17.4 Type “T” then hit RETURN to continue, or type “E” then hit RETURN to go to the main menu.

5.17.5 Type “N” then hit RETURN.

5.17.6 Type name of file (max. 8 characters) then hit RETURN.

5.17.7 Hit RETURN to begin.

5.17.8 Type “T” then type the message "LETS GO TO THE START POSITION" then hit RETURN.

5.17.9 Drive the carriage and mandrel to the position where you intend to load and attach cable.

5.17.10 Type “T” then type the message "DRIVING TO START POSITION" then hit RETURN.

5.17.11 Type “T” then type the message "LOAD AND ATTACH CABLE" then hit RETURN.

5.17.12 Load and attach cable per section 5.10 "Cable Loading And Tension Adjustment".

5.17.13 Type “T” then type the message "SET TENSION TO ?" Then hit RETURN.

5.17.14 Set tension per procedure mentioned in step 12.

5.17.15 Drive to the next aim point, then hit "T" and RETURN. Note: Text line will appear but do not enter any if this is not an operator prompt point in the program. To prompt for work to be performed you should be at the position at which the work will be done, and have entered that position per this step. Without moving the carriage or mandrel type "T" then type the work instructions, then hit RETURN.

5.17.16 Repeat previous step until coil is complete, or the shift has ended.

**CAUTION**

**If you are stopping due to a shift end you must record the carriage and mandrel positions shown on the Position Control Panel. This is in case of power failure.**

5.17.17 Type "E".

5.17.18 Type "E" again then hit RETURN.

5.17.19 File is saved on hard drive automatically. It is advisable to also save the file on a floppy disk. To do this see section 5.21 "Saving a Winding File to Disc".

**CAUTION**

**Do not turn off power supply or computer unless the winding file is 100% complete.**

5.18 Completing An Unfinished Coil Winding File

5.18.1 Go to the main menu.

5.18.2 Verify that the "hand/auto" switch on the Position Controller Panel is in the hand position.

5.18.3 Type "1" then hit RETURN.

5.18.4 Type "T" then hit RETURN to continue, or type "E" then hit RETURN to go to the main menu.

5.18.5 Type "O" then hit RETURN.

5.18.6 Type name of file you wish to continue, then hit RETURN.

5.18.7 Type the carriage position where you left off. Then hit RETURN.

5.18.8 To continue programming hit RETURN.

5.18.9 Drive to the next aim point, then hit "T" and RETURN. Note: Text line will appear but do not enter any if this is not an operator prompt point in the program. To prompt for work to be performed you should be at the position at which the work will be done, and have entered that position per this step. Without moving the carriage or mandrel, type "T" then type the work instructions, then hit RETURN.

5.18.10 Repeat previous step until coil is complete, or the shift has ended.

**CAUTION**

**If you are stopping due to a shift end you must record the carriage and mandrel positions shown on the Position Controller Panel. This is in case of power failure.**

5.18.11 Type "E".

5.18.12 Type "E" again then hit RETURN.

5.18.13 File is saved on hard drive automatically. It is advisable to also save the file on a floppy disk. To do this see section 5.21.

**CAUTION**

**Do not turn off power supply or computer unless the winding file is 100% complete.**

5.19 Editing A Winding File

5.19.1 From main menu type "2" then hit RETURN

5.19.2 Type the name of the winding file that you wish to edit then hit RETURN

5.19.3 Program will appear on screen. Move through the program using the arrow keys or the page up page down keys.

5.19.4 Make corrections as required. Be sure to hit RETURN after each correction and be sure to keep columns straight.

5.19.5 When you have completed the corrections hold down STRG key while hitting the end key to save the changes.

5.19.6 Hit RETURN to go to the main menu.

5.20 Repairing A File That Is Missing End Key

5.20.1 When a program doesn't end properly, and requires a boot or break to exit from the "EXECUTE PROGRAM" mode, it is probably missing an "end key".

5.20.2 To verify this, go to the main menu and type “2” then hit RETURN.

5.20.3 Type the file name then hit RETURN

5.20.4 If message appears stating "MISSING END KEY", you have verification.

5.20.5 Press any key, then hit RETURN to go to the main menu.

5.20.6 At main menu type “6” then hit RETURN.

5.20.7 Place cursor on the file that is bad, using the tab and arrow keys. Hit F3 key when done.

5.20.8 Hit the end key to show you the last line of the program.

**NOTE**

**Record the number of the last line.**

5.20.9 Hit F10 key.

5.20.10 Type GRUMMAN then hit RETURN. Main menu will appear.

5.20.11 Type “7” then hit RETURN.

5.20.12 Type the drive letter where the bad file is located.(ex. C: then hit RETURN).

5.20.13 Type name of bad file then hit RETURN.

5.20.14 Type last line# [previously recorded in step (8)]) then hit RETURN.

5.20.15 Type new file name (file must be re-named) then hit RETURN. Bad file can be deleted at a later time.

5.20.16 Type "Y" then hit RETURN.

5.20.17 Press any key, then hit RETURN.

5.20.18 Type "E" then hit RETURN.

5.20.19 Program is now repaired and should now run properly. You can verify that the end key exists by looking at the last line in the edit mode. (see section 5.19).

5.21 Saving a Winding File to Disc

5.21.1 Go to main menu.

5.21.2 Type "5" then hit RETURN.

5.21.3 Type "2" then hit RETURN.

5.21.4 Insert floppy disk into floppy drive, then hit RETURN at least one directory or file must exist on disk for this procedure to work.

5.21.5 Type the name of the file you wish to save to floppy disk, then hit RETURN.

5.21.6 Type the file name as you wish it to appear on the floppy disk, then hit RETURN.

5.21.7 Remove floppy disk.

5.21.8 Hit RETURN.

5.21.9 Type END to go to main menu.

5.22 Printing Winding Files Using Print Disc

5.22.1 Copy winding file to a "print disc". See section 5.21. Print disc can be obtained from supervisor.

5.22.2 Insert "print disc" into floppy drive.

5.22.3 Change control of computer to the drive in which you installed the "PRINT DISC". Ex. Type a: then hit RETURN.

5.22.4 Type print then hit RETURN.

5.22.5 Type “R” then hit RETURN.

5.22.6 Type the name of the file you wish to print, then hit RETURN.

5.22.7 Type end then hit RETURN.

5.23 Interlock Test Procedure

**NOTE 1**

**Two operators, designated “Operator 1” and “Operator 2”, are required to perform this section.**

**NOTE 2**

**The interlock test procedure should be performed at a six month interval.**

*Operator 1:*

5.23.1 Set all controls to their “initial” settings.

5.23.2 Activate the Winder in the Manual Mode.

**WARNING**

**Failure to follow step 5.23.3 could result in unexpected machine motion and possible injury.**

5.23.3 Verify that the TENSION CONTROL potentiometer, located on the carriage is set to its lowest possible setting.

5.23.4 Engage main brake located on carriage.

5.23.5 Release main brake.

5.23.6 Move the carriage and mandrel using the remote control.

5.23.7 While the spindle, carriage, and mandrel are in motion, depress the EMERGENCY STOP push button on the Position Controller Panel.

5.23.8 If all machine motion stops: Then check the appropriate box on the Interlock Test Form (Attachment 2).

5.23.9 If all machine motion does not stop: Then stop work, write "fail" on the Interlock Test Form, and notify the Cognizant Engineer, the Cognizant Technical Supervisor, and the ES&H Coordinator.

**WARNING**

**Personnel should stand away from the carriage before step 5.23.11 is performed.**

5.23.10 Reset emergency stop button. Depress the green START push button on the Position Controller Panel. The spindle should rotate.

5.23.11 Move the carriage and mandrel using the remote controls.

*Operator 2:*

5.23.12 While spindle, carriage, and mandrel are in motion, depress the EMERGENCY STOP push button on the Remote Control.

*Operator 1:*

5.23.13 If all machine motion stops: Then check the appropriate box on the Interlock Test Form.

5.23.14 If all machine motion does not stop: Then stop work, write "fail" on the Interlock Test Form, and notify the Cognizant Engineer, the Cognizant Technical Supervisor, and the ES&H Coordinator.

5.23.15 Reset emergency stop button. Depress the green START push button on the Position Controller Panel. The spindle should rotate.

5.23.16 Move the carriage and mandrel using the remote controls.

*Operator 2:*

**WARNING**

**The next step requires that you stand within the yellow border. Do not allow your clothes or body to come in contact with any moving parts. Do not linger in the area or become distracted.**

5.23.17 While the spool holder, carriage, and mandrel are in motion, and while the carriage is moving away from you, step next to the carriage and depress the stop push bar on the carriage.

*Operator 1:*

5.23.18 If all machine motion stops: Then check the appropriate box on the Interlock Test Form.

5.23.19 If all machine motion does not stop: Then stop work, write "fail" on the Interlock Test Form, and notify the Cognizant Engineer, the Cognizant Technical Supervisor, and the ES&H Coordinator.

5.23.20 Repeat steps 5.23.16 to 5.23.20 for the other STOP push bar on the carriage.

5.23.21 Initial and date the Interlock Test Form. Post the Form near the Winder.

5.24 Changing The Carriage Direction

**NOTE**

**To change the carriage direction, the carriage wheel assembly (located under the carriage) must be turned around $180^0$ manually to prevent the wheel assembly from binding on the floor.**

5.24.1 Use a length of box tubing (5' x 1" x 1.5" or equivalent) to turn the wheel assembly.

**NOTE**

**If the wheel assembly binds, use the green START button on the Position Controller Panel to restart the carriage.**

## 6.0 Documentation

6.1 Coil Winder Log Book

6.2 Magnet Travelers.

6.3 Interlock Test Form.

6.4 Maintenance Log.

6.5 Magnet Assembly Procedure

6.6 Calibration Report

## 7.0 References

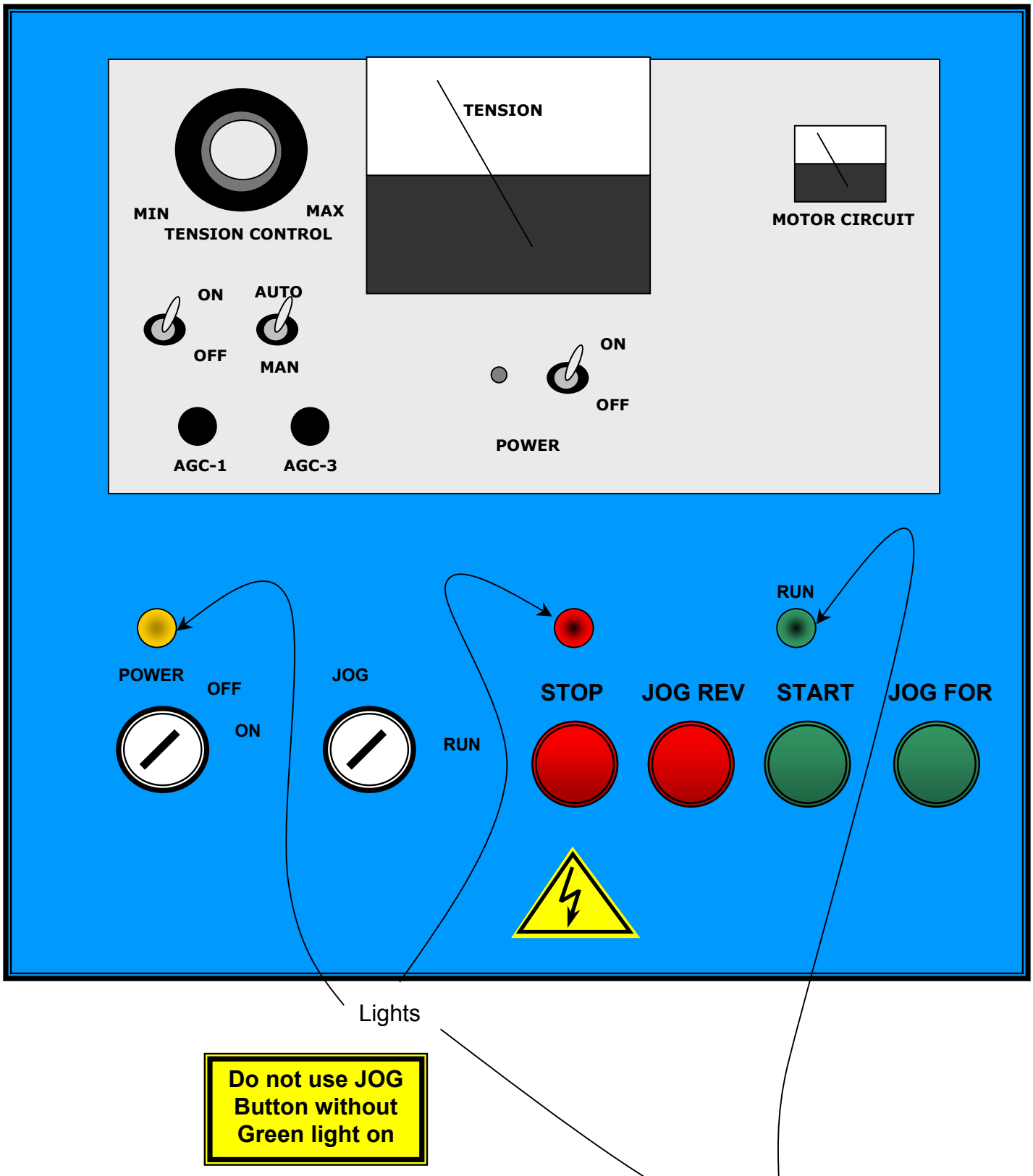
7.1 BNL ES & H Manual 1.5.1, “Lockout/Tagout Requirements”.

7.2 BNL ES & H Manual 1.5.0, “Electrical Safety”.

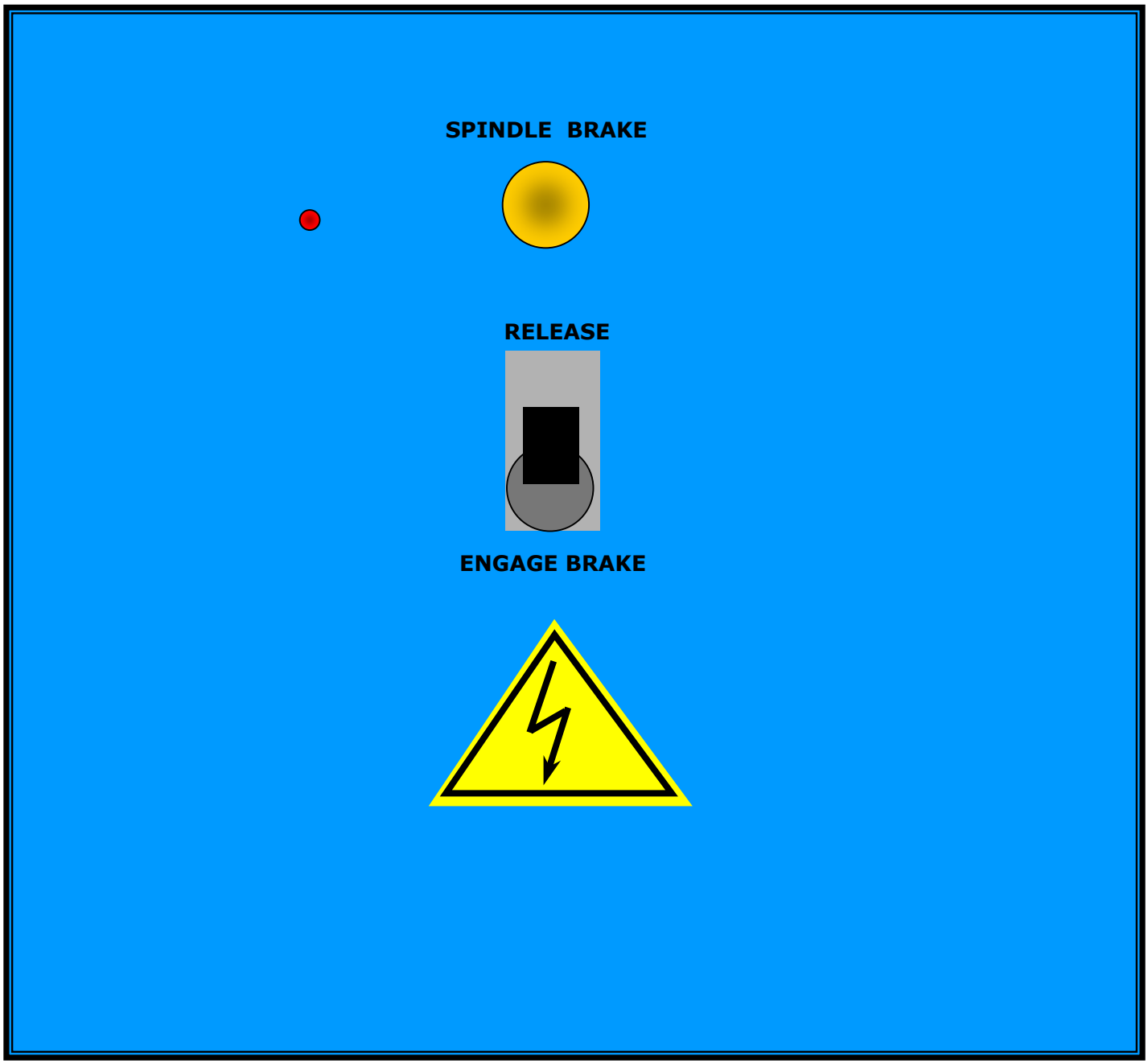
## 8.0 Attachments

1. Carriage Control Panel
2. Remove Control
3. Winder Control Panel
4. Position Controller Panel
5. Cable Routing Diagram
6. Calibration Report
7. Interlock Test Form

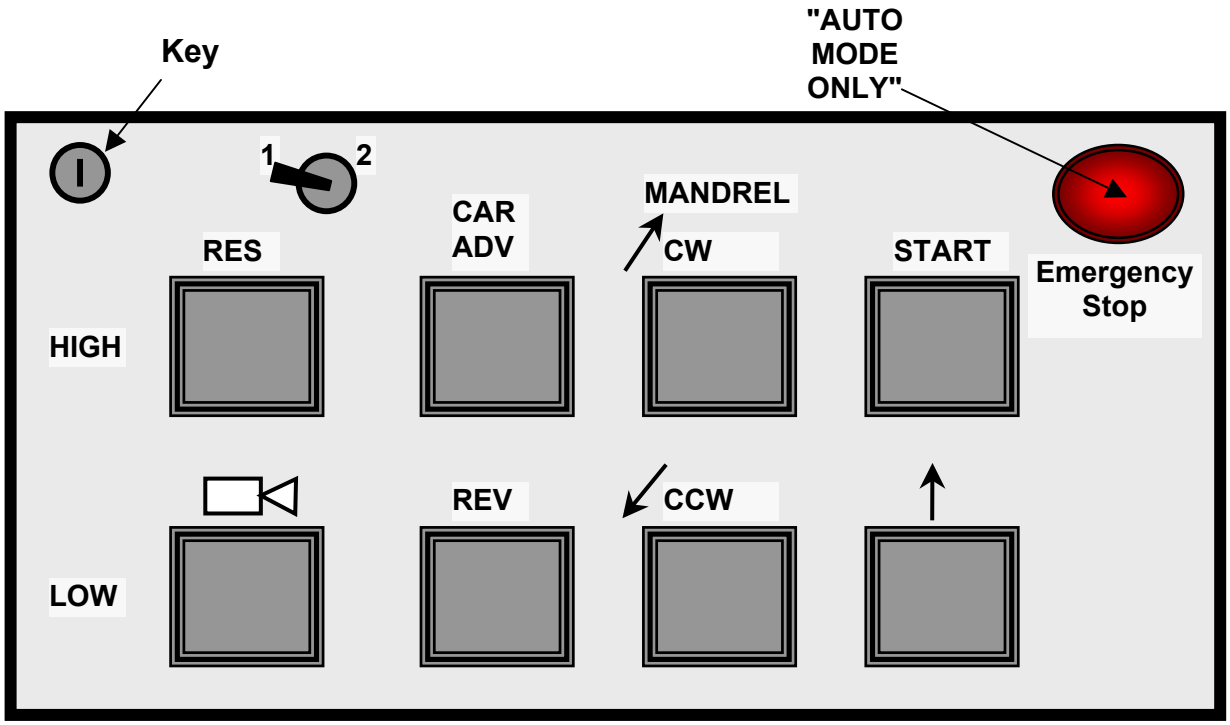
## Attachment 1 - Carriage Control Panel - Front



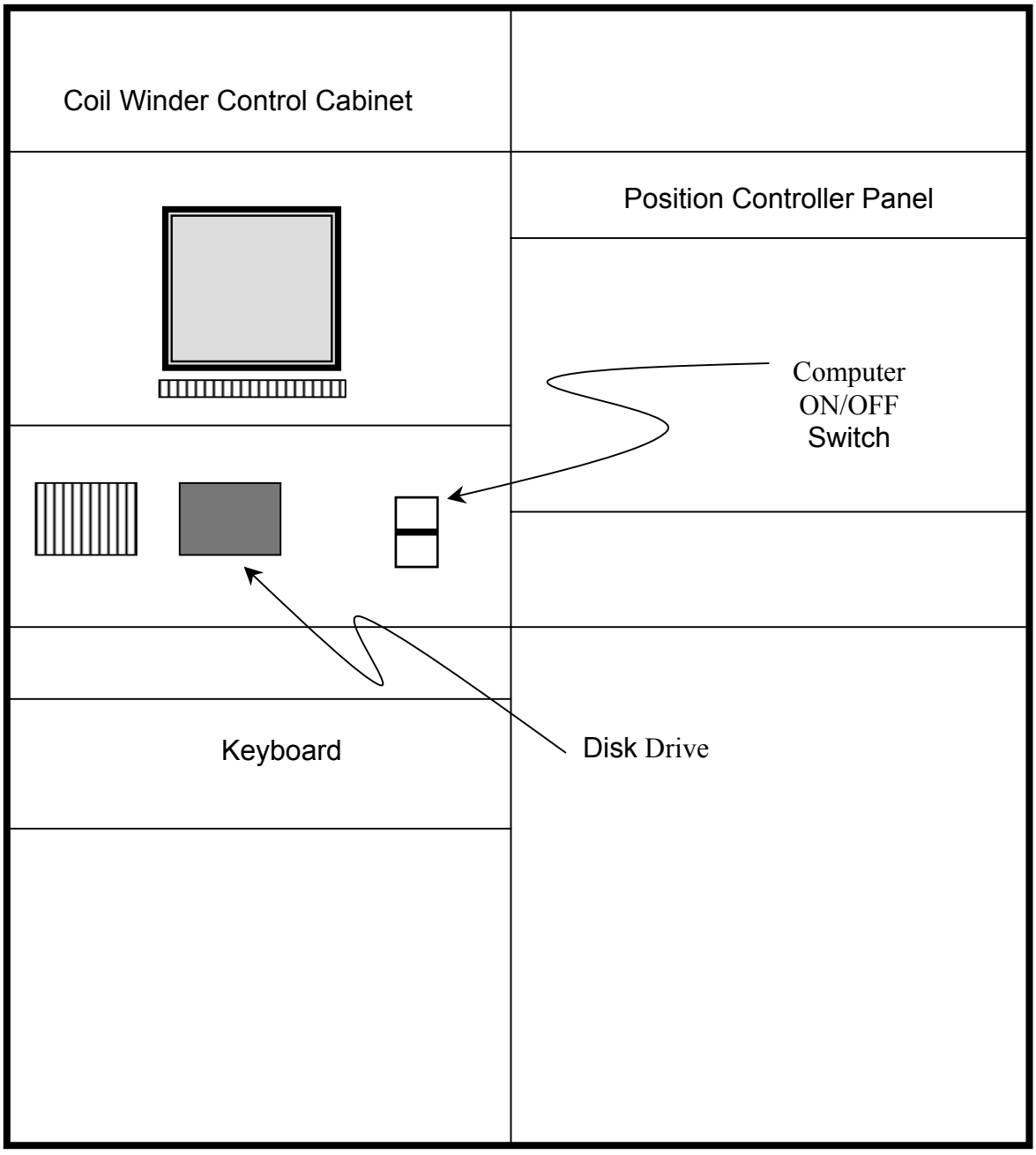
## Attachment 1 (cont'd) - Carriage Control Panel - Side



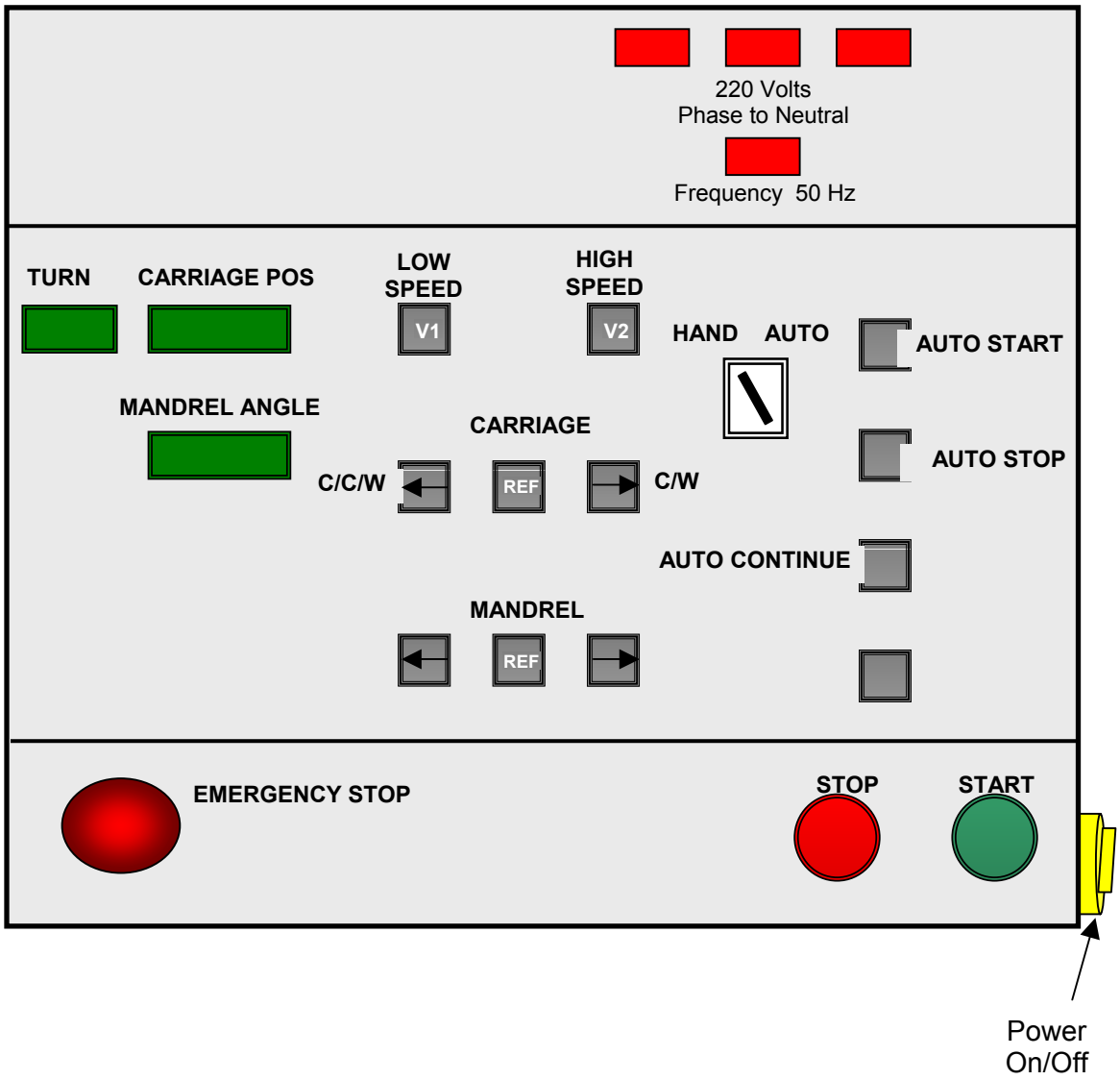
## Attachment 2 - Remote Control



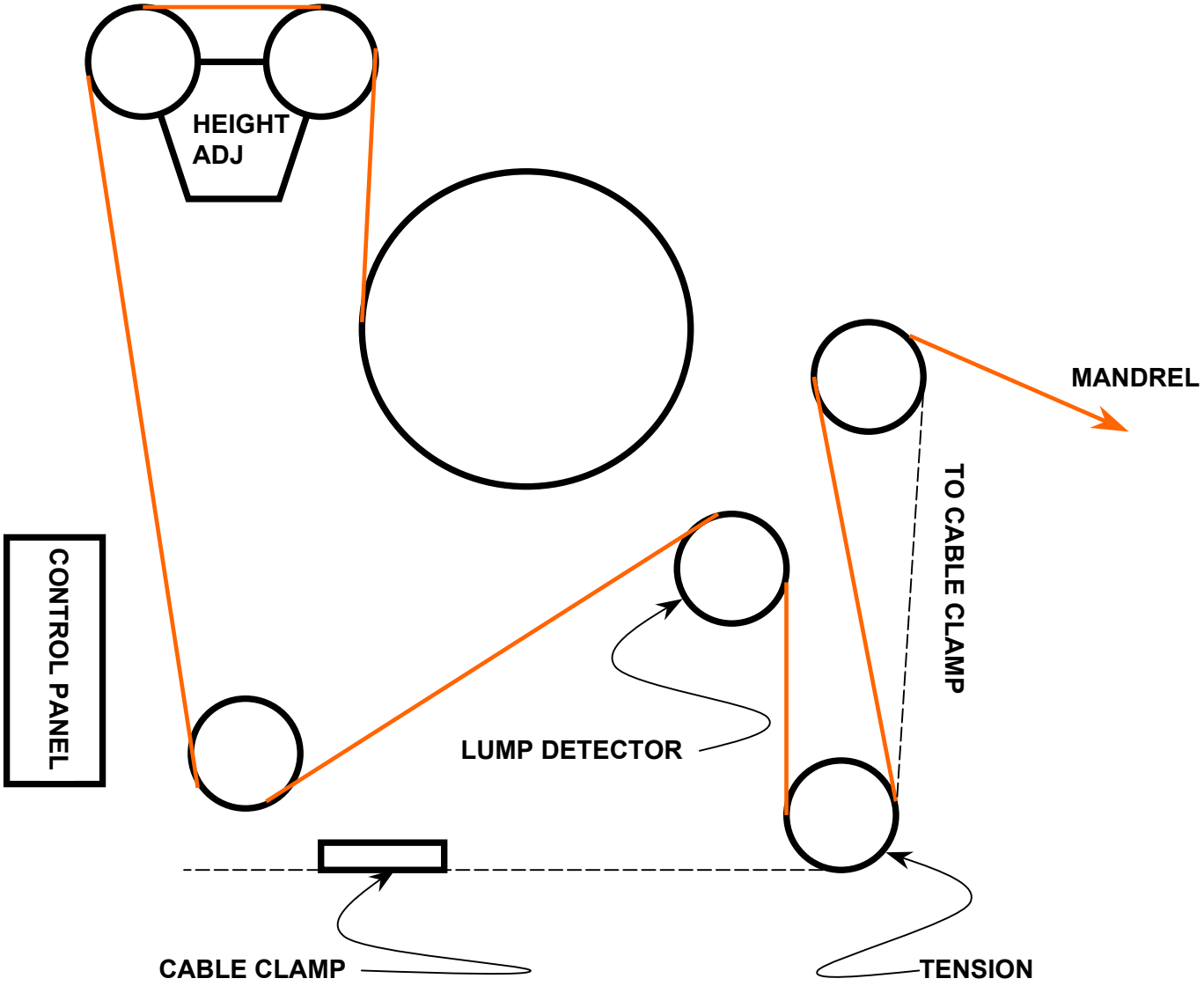
## Attachment 3 - Winder Control Unit



## Attachment 4 – Position Controller Panel



## Attachment 5 - Cable Routing thru Guide Rollers



## Attachment 6

No._____

Superconducting Magnet Division Calibration Group
Calibration Report

Title: Long Dipole Cable Tensioning System

Service Date_____ By_____

THIS ASSET WAS CALIBRATED USING TEST EQUIPMENT WHOSE ACCURACY IS TRACEABLE TO THE NIST, OR ACCEPTED VALUES OF NATURAL PHYSICAL CONSTANTS.

***TEST DATA***

***Equipment: Chatillon Dial Push-Pull Gauge, Model DDP ID#_____***

| | | *Before Adjustment* | | *After Adjustment* | |
|---|---|---|---|---|---|
| ***Specified Tolerance*** | ***Applied Tension (lbs.)*** | ***Read*** | ***Fail (*)*** | ***Read*** | ***Fail (*)*** |
| ***+/-2.5 lbs.*** | ***0*** | | | | |
| | ***5*** | | | | |
| | ***10*** | | | | |
| | ***15*** | | | | |
| | ***20*** | | | | |
| | ***25*** | | | | |
| | ***30*** | | | | |
| | ***35*** | | | | |
| | ***40*** | | | | |
| | ***45*** | | | | |

***Service notes:*** ***Temp:***

***Calibration Date:***

Humidity: Calibration Due:

## Attachment 7
Interlock Test Form

Instructions:

1. Post this form near the winder
2. Do not operate the winder if the interlocks have not been tested within the past six months.
3. Refer to the Operations Procedure for the Winder for the proper interlock test method.
4. Check box as each device is tested. Initial and date the form. If an interlock fails the test, write "fail" in the appropriate box and notify the Cognizant Engineer and the Safety Coordinator immediately.

| **Check Points** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **W-1** | | | | | | | | | | |
| **W-2** | | | | | | | | | | |
| **W-3** | | | | | | | | | | |
| **W-4** | | | | | | | | | | |
| **Initials** | | | | | | | | | | |
| **Date** | | | | | | | | | | |